



(11) **EP 3 370 016 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
31.03.2021 Bulletin 2021/13

(51) Int Cl.:
F25B 1/10 (2006.01) **F25B 5/02** (2006.01)
F25B 9/00 (2006.01)

(21) Application number: **18154770.4**

(22) Date of filing: **01.02.2018**

(54) **COOLING SYSTEM WITH PARALLEL COMPRESSION**

KÜHLSYSTEM MIT PARALLELEN KOMPRESSOREN

SYSTÈME DE REFROIDISSEMENT À COMPRESSION PARALLÈLE

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(30) Priority: **02.03.2017 US 201715448341**

(43) Date of publication of application:
05.09.2018 Bulletin 2018/36

(73) Proprietor: **Heatcraft Refrigeration Products LLC
Stone Mountain, GA 30087 (US)**

(72) Inventor: **ZHA, Shitong
Snellville, GA Georgia 30078 (US)**

(74) Representative: **Barker Brettell LLP
100 Hagley Road
Edgbaston
Birmingham B16 8QQ (GB)**

(56) References cited:
**EP-A1- 3 064 866 WO-A1-2017/023632
DE-A1-102014 100 917 DE-A1-102015 112 439
US-A1- 2014 326 018**

EP 3 370 016 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

TECHNICAL FIELD

[0001] This disclosure relates generally to a cooling system, specifically cooling system with parallel compression.

BACKGROUND

[0002] Cooling systems may cycle a refrigerant to cool various spaces. For example, a refrigeration system may cycle refrigerant to cool spaces near or around refrigeration loads.

[0003] EP3064866A1 discloses a modulated oversized compressor configuration for flash gas bypass in a carbon dioxide refrigeration system, in which a refrigeration system includes a flash tank, a number of temperature suction compressors and a flash gas bypass system positioned between the flash tank and the cycle compressors, the flash gas bypass system including one or more oversized flash gas compressors so as to alternate between the temperature suction cycle and a flash tank suction cycle.

SUMMARY OF THE DISCLOSURE

[0004] In accordance with the invention there is provided a method and system as defined by the appended claims.

[0005] According to one example disclosed herein, a system includes a high side heat exchanger, a first load, a second load, a third load, a first compressor, a second compressor, a third compressor, and a fourth compressor. The high side heat exchanger removes heat from a refrigerant. The first load uses the refrigerant to remove heat from a first space proximate the first load. The second load uses the refrigerant to remove heat from a second space proximate the second load. The third load uses the refrigerant to remove heat from a third space proximate the third load. The first compressor compresses the refrigerant from the first load. The second compressor compresses the refrigerant from the second load. The third compressor compresses the refrigerant from the third load and the refrigerant from the second compressor. The fourth compressor compresses the refrigerant from the first compressor.

[0006] According to another example, a method includes removing heat from a refrigerant using a high side heat exchanger and removing heat from a first space proximate a first load using the refrigerant. The method also includes removing heat from a second space proximate a second load using the refrigerant and removing heat from a third space proximate a third load using the refrigerant. The method further includes compressing the refrigerant from the first load using a first compressor and compressing the refrigerant from the second load using a second compressor. The method also includes com-

pressing the refrigerant from the third load and the refrigerant from the second compressor using a third compressor and compressing the refrigerant from the first compressor using a fourth compressor.

[0007] According to yet another example, a system includes a first load, a second load, a third load, a first compressor, a second compressor, a third compressor, and a fourth compressor. The first load uses a refrigerant to remove heat from a first space proximate the first load. The second load uses the refrigerant to remove heat from a second space proximate the second load. The third load uses the refrigerant to remove heat from a third space proximate the third load. The first compressor compresses the refrigerant from the first load. The second compressor compresses the refrigerant from the second load. The third compressor compresses the refrigerant from the third load and the refrigerant from the second compressor. The fourth compressor compresses the refrigerant from the first compressor.

[0008] Certain embodiments may provide one or more technical advantages. For example, an embodiment improves the cooling efficiency of a cooling system by at least 5 to 10% compared to existing cooling systems. Certain embodiments may include none, some, or all of the above technical advantages. One or more other technical advantages may be readily apparent to one skilled in the art from the figures, descriptions, and claims included herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] For a more complete understanding of the present invention, reference is now made to the following description, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 illustrates an example cooling system not according to the invention;

FIGURE 2 illustrates a cooling system according to the invention; and

FIGURE 3 is a flowchart illustrating a method of operating the cooling system of FIGURE 2.

DETAILED DESCRIPTION

[0010] Embodiments of the present invention and its advantages are best understood by referring to FIGURES 1 through 3 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

[0011] Cooling systems may cycle a refrigerant to cool various spaces. For example, a refrigeration system may cycle refrigerant to cool spaces near or around refrigeration loads. In certain installations, such as at a grocery store for example, a refrigeration system may include different types of loads. For example, a grocery store

may use medium temperature loads and low temperature loads. The medium temperature loads may be used for produce and the low temperature loads may be used for frozen foods. The compressors for these loads may be chained together. For example, the discharge of the low temperature compressor for the low temperature load may be fed into the medium temperature compressor that also compresses the refrigerant from the medium temperature loads. The discharge of the medium temperature compressor is then fed to a high side heat exchanger that removes heat from the compressed refrigerant.

[0012] When grocery stores want to expand their frozen food selection, grocery stores may add more low temperature loads, such as for example freezer cases, to the refrigeration system. Each additional low temperature load may be accompanied by an additional low temperature compressor. The discharge of each low temperature compressor may then be fed to the existing medium temperature compressor. As the number of low temperature loads increases so does the strain that is put on the medium temperature compressor. The more work the medium temperature compressor does, the lower the efficiency of the overall refrigeration system. The reduced efficiency may result in increased energy costs.

[0013] This invention contemplates a configuration of a refrigeration system that includes a parallel compressor that compresses the refrigerant from the low temperature compressors rather than the medium temperature compressor. This configuration may result in an improvement in the efficiency of the refrigeration system when additional low temperature loads are added to the refrigeration system. In some embodiments, the configuration may result in an efficiency gain of five to ten percent. In certain embodiments, the efficiency gain may be greater than ten percent. The system will be described in more detail using FIGURES 1 through 3. FIGURE 1 will describe an existing refrigeration system. FIGURES 2 and 3 will describe the refrigeration system with parallel compression.

[0014] FIGURE 1 illustrates an example cooling system 100. As shown in FIGURE 1, system 100 includes a high side heat exchanger 105, a flash tank 110, a medium temperature load 115, a low temperature load 120, a low temperature load 125, a medium temperature compressor 130, a low temperature compressor 135, and a low temperature compressor 140.

[0015] High side heat exchanger 105 removes heat from a refrigerant. When heat is removed from the refrigerant, the refrigerant is cooled. This disclosure contemplates high side heat exchanger 105 being operated as a condenser, a fluid cooler, and/or a gas cooler. When operating as a condenser, high side heat exchanger 105 cools the refrigerant such that the state of the refrigerant changes from a gas to a liquid. When operating as a fluid cooler, high side heat exchanger 105 cools liquid refrigerant and the refrigerant remains a liquid. When operating as a gas cooler, high side heat exchanger 105 cools

gaseous refrigerant and the refrigerant remains a gas. In certain configurations, high side heat exchanger 105 is positioned such that heat removed from the refrigerant may be discharged into the air. For example, high side heat exchanger 105 may be positioned on a rooftop so that heat removed from the refrigerant may be discharged into the air. As another example, high side heat exchanger 105 may be positioned external to a building and/or on the side of a building.

[0016] Flash tank 110 stores refrigerant received from high side heat exchanger 105. This invention contemplates flash tank 110 storing refrigerant in any state such as, for example, a liquid state and/or a gaseous state. Refrigerant leaving flash tank 110 is fed to low temperature load 120, low temperature load 125, and medium temperature load 115. A flash gas and/or a gaseous refrigerant is released from flash tank 110. By releasing flash gas, the pressure within flash tank 110 may be reduced.

[0017] System 100 includes a low temperature portion and a medium temperature portion. The low temperature portion operates at a lower temperature than the medium temperature portion. In some refrigeration systems, the low temperature portion may be a freezer system and the medium temperature system may be a regular refrigeration system. In a grocery store setting, the low temperature portion may include freezers used to hold frozen foods, and the medium temperature portion may include refrigerated shelves used to hold produce. Refrigerant flows from flash tank 110 to both the low temperature and medium temperature portions of the refrigeration system. For example, the refrigerant may flow to low temperature load 120, low temperature load 125, and medium temperature load 115. When the refrigerant reaches low temperature load 120, low temperature load 125, or medium temperature load 115, the refrigerant removes heat from the air around low temperature load 120, low temperature load 125, or medium temperature load 115. As a result, the air is cooled. The cooled air may then be circulated such as, for example, by a fan to cool a space such as, for example, a freezer and/or a refrigerated shelf. As refrigerant passes through low temperature load 120, low temperature load 125, and medium temperature load 115, the refrigerant may change from a liquid state to a gaseous state as it absorbs heat.

[0018] Refrigerant flows from low temperature load 120, low temperature load 125, and medium temperature load 115 to compressors 130, 135, and 140. This disclosure contemplates system 100 including any number of low temperature compressors 135, 140 and medium temperature compressors 130. The low temperature compressors 135, 140 and medium temperature compressor 130 are configured to increase the pressure of the refrigerant. As a result, the heat in the refrigerant becomes concentrated and the refrigerant becomes a high pressure gas. Low temperature compressor 135 compresses refrigerant from low temperature load 120 and sends the compressed refrigerant to medium temperature com-

pressor 130. Low temperature compressor 140 compresses refrigerant from low temperature load 125 and sends the compressed refrigerant to medium temperature compressor 130. Medium temperature compressor 130 compresses refrigerant from low temperature compressors 135 and 140 and medium temperature load 115. Medium temperature compressor 130 sends the compressed refrigerant to high side heat exchanger 105.

[0019] As shown in FIGURE 1, the discharges of low temperature compressor 135 and low temperature compressor 140 are fed to medium temperature compressor 130. Medium temperature compressor 130 then compresses the refrigerant from medium temperature load 115, low temperature compressor 135, and low temperature compressor 140. As additional low temperature loads and/or low temperature compressors are added to system 100, the strain on medium temperature compressor 130 increases. As medium temperature compressor 130 does more work, the overall efficiency of system 100 falls. As a result of the reduced efficiency, operating system 100 may result in increased energy costs.

[0020] FIGURE 2 illustrates a cooling system 200 according to the invention. As shown in FIGURE 2, system 200 includes a high side heat exchanger 105, a flash tank 110, a medium temperature load 115, a low temperature load 120, a low temperature load 125, a medium temperature compressor 130, a low temperature compressor 135, a low temperature compressor 140, a parallel compressor 205, and a valve 210. System 200 includes several components that are also in system 100. These components operate similarly as they did in system 100. System 200 improves the efficiency of medium temperature compressor 130 over system 100. As a result, system 200 may reduce energy costs compared to system 100.

[0021] The primary difference between system 200 and system 100 is the use of parallel compressor 205. In system 200, the discharge of low temperature compressor 135 is fed to parallel compressor 205 instead of medium temperature compressor 130. Parallel compressor 205 also compresses a flash gas from flash tank 110. By using parallel compressor 205, the amount of work that medium temperature 130 does is reduced. In certain embodiments, system 200 may see at least a five to ten percent efficiency gain over system 100.

[0022] A first valve 210 controls where the discharge of low temperature compressor 135 goes. For example, the first valve 210 may direct the discharge of low temperature compressor 135 to parallel compressor 205. As another example, the first valve 210 may direct the discharge of low temperature compressor 135 to medium temperature compressor 130. In this manner, the strain on parallel compressor 205 and medium temperature compressor 130 may be adjusted using the first valve 210. In particular embodiments, the first valve 210 is a three-way valve. For example, the first valve 210 may receive refrigerant from low temperature compressor 135 and direct the refrigerant either to parallel compressor 205 or medium temperature compressor 130, or to both.

[0023] On occasion, parallel compressor 205 may be turned off for various reasons such as, for example, maintenance. When parallel compressor 205 is turned off, the first valve 210 is adjusted to direct the refrigerant from low temperature compressor 135 to medium temperature compressor 130. When maintenance is complete and parallel compressor 205 is turned back on, the first valve 210 is adjusted to direct the refrigerant from low temperature compressor 135 back to parallel compressor 205.

[0024] System 200 includes a second valve that directs flash gas from flash tank 110 to medium temperature compressor 130 when parallel compressor 205 is turned off. For example, if parallel compressor 205 is undergoing maintenance, then the second valve is adjusted to direct flash gas from flash tank 110 to medium temperature compressor 130. When maintenance is complete, the second valve is adjusted again to direct flash gas from flash tank 110 to parallel compressor 205.

[0025] In certain embodiments, medium temperature load 115 may be at a higher temperature than low temperature load 120 and low temperature load 125. Furthermore, low temperature load 125 may be at a lower temperature than low temperature load 120. This disclosure contemplates medium temperature load 115, low temperature load 120, and low temperature load 125 operating at any temperature relative to each other.

[0026] In particular embodiments, system 200 includes an oil separator before high side heat exchanger 105. The oil separator may separate oils from the refrigerant from medium temperature compressor 130 and parallel compressor 205. By separating the oil from the refrigerant, it may be easier for high side heat exchanger 105 to remove heat from the refrigerant. Additionally, separating oil from the refrigerant may increase the lifetime and/or efficiency of other components of system 200. The oil separator may separate the oil from the refrigerant and send the refrigerant to high side heat exchanger 105.

[0027] This invention contemplates system 200 including any number of components. For example, system 200 may include any number of low temperature loads, medium temperature loads, and air conditioning loads. As another example, system 200 may include any number of low temperature compressors, medium temperature compressors, and parallel compressors. As yet another example, system 200 may include any number of high side heat exchangers 105 and flash tanks 110. This disclosure also contemplates cooling system 200 using any appropriate refrigerant. For example, cooling system 200 may use a carbon dioxide refrigerant.

[0028] FIGURE 3 is a flowchart illustrating a method 300 of operating the cooling system 200 of FIGURE 2. Various components of system 200 perform the steps of method 300. In certain embodiments, performing method 300 may improve the efficiency of a cooling system by at least five to ten percent.

[0029] High side heat exchanger 105 begins by removing heat from a refrigerant in step 305. In step 310, low temperature load 120 removes heat from a first space

using the refrigerant. In step 315, low temperature load 125 removes heat from a second space using the refrigerant. In step 320, medium temperature load 115 removes heat from a third space using the refrigerant. In step 325, low temperature compressor 135 compresses refrigerant from low temperature load 120. In step 330, low temperature compressor 140 compresses refrigerant from low temperature load 125. Medium temperature compressor 130 compresses refrigerant from medium temperature load 115 and low temperature compressor 140 in step 335. In step 340, parallel compressor 205 compresses refrigerant from low temperature compressor 135.

[0030] Modifications, additions, or omissions may be made to method 300 depicted in FIGURE 3. Method 300 may include more, fewer, or other steps. For example, steps may be performed in parallel or in any suitable order. While discussed as various components of cooling system 200 performing the steps, any suitable component or combination of components of system 200 may perform one or more steps of the method.

[0031] Although the present disclosure includes several embodiments, a myriad of changes, variations, alterations, transformations, and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompass such changes, variations, alterations, transformations, and modifications as fall within the scope of the appended claims.

Claims

1. A method comprising:

removing heat from a refrigerant using a high side heat exchanger (105);
 storing the refrigerant from the high side heat exchanger (105) using a flash tank (110);
 discharging a flash gas from the flash tank (110);
 removing heat from a first space proximate a first low temperature load (120) using the refrigerant;
 removing heat from a second space proximate a second low temperature load (125) using the refrigerant;
 removing heat from a third space proximate a medium temperature load (115) using the refrigerant;
 compressing the refrigerant from the first low temperature load (120) using a first low temperature compressor (135);
 compressing the refrigerant from the second low temperature load (125) using a second low temperature compressor (140);
 compressing the refrigerant from the medium temperature load (115) and the refrigerant from the second low temperature compressor (140) using a medium temperature compressor (130);

when a parallel compressor (205) is on:

directing, by a first valve (210), the refrigerant from the first low temperature compressor (135) to the parallel compressor (205) and away from the medium temperature compressor (130); and
 compressing the refrigerant from the first low temperature compressor (135) and the flash gas using the parallel compressor (205);

when the parallel compressor (205) is off:

directing, by the first valve (210), the refrigerant from the first low temperature compressor (135) to the medium temperature compressor (130) and away from the parallel compressor (205);
 directing, by a second valve, the flash gas from the flash tank to the medium temperature compressor (130) and away from parallel compressor (205); and
 compressing, by the medium temperature compressor (130), the refrigerant from the first low temperature compressor (135) and the flash gas.

2. The method of claim 1, wherein the first valve is a three-way valve (210).

3. The method of any preceding claim, wherein:

the third space is at a higher temperature than both the first space and the second space; and
 the second space is at a lower temperature than the first space.

4. The method of any preceding claim, further comprising:

receiving the refrigerant from the medium temperature compressor (130) and the parallel compressor (205) at an oil separator; and
 sending the refrigerant to the high side heat exchanger (105).

5. A system (200) for performing the method of claim 1, comprising:

a high side heat exchanger (105) configured to remove heat from a refrigerant;
 a flash tank (110) configured to store the refrigerant from the high side heat exchanger (105), the flash tank (110) configured to discharge a flash gas;
 a first low temperature load (120) configured to use a refrigerant to remove heat from a first

space proximate the first low temperature load (120);
 a second low temperature load (125) configured to use the refrigerant to remove heat from a second space proximate the second low temperature load (125);
 a medium temperature load (115) configured to use the refrigerant to remove heat from a third space proximate the medium temperature load (115);
 a first low temperature compressor (135) configured to compress the refrigerant from the first low temperature load (120);
 a second low temperature compressor (140) configured to compress the refrigerant from the second low temperature load (125);
 a medium temperature compressor (130) configured to compress the refrigerant from the medium temperature load (115) and the refrigerant from the second low temperature compressor (140);
 a first valve (210);
 a second valve; and
 a parallel compressor (205),
 wherein, when the parallel compressor (205) is on:

the first valve (210) is configured to direct the refrigerant from the first low temperature compressor (135) to the parallel compressor (205) and away from the medium temperature compressor (130); and
 the parallel compressor (205) is configured to compress the refrigerant from the first low temperature compressor (135) and the flash gas;

and wherein, when the parallel compressor (205) is off:

the first valve (210) is configured to direct the refrigerant from the first low temperature compressor (135) to the medium temperature compressor (130) and away from the parallel compressor (205);
 the second valve is configured to direct the flash gas from the flash tank to the medium temperature compressor (130) and away from parallel compressor (205); and
 the medium temperature compressor (130) is further configured to compress the refrigerant from the first low temperature compressor (135) and the flash gas.

6. The system of claim 5, wherein the first valve is a three-way valve (210).

7. The system of claim 5 or claim 6, wherein:

the third space is at a higher temperature than both the first space and the second space; and the second space is at a lower temperature than the first space.

8. The system of any of claims 5 to 7, further comprising an oil separator configured to:

receive the refrigerant from the medium temperature compressor (130) and the parallel compressor (205); and
 send the refrigerant to a high side heat exchanger (105).

Patentansprüche

1. Verfahren, das die folgenden Schritte umfasst:

Abführen von Wärme von einem Kühlmittel unter Verwendung eines hochseitigen Wärmetauschers (105);
 Speichern des Kühlmittels von dem hochseitigen Wärmetauscher (105) unter Verwendung eines Entspanners (110);
 Abführen von Flash-Gas aus dem Entspanner (110);
 Abführen von Wärme von einem ersten Raum angrenzend an eine erste Niedertemperaturlast (120) unter Verwendung des Kühlmittels;
 Abführen von Wärme von einem zweiten Raum angrenzend an eine zweite Niedertemperaturlast (125) unter Verwendung des Kühlmittels;
 Abführen von Wärme von einem dritten Raum angrenzend an eine Mitteltemperaturlast (115) unter Verwendung des Kühlmittels;
 Komprimieren des Kühlmittels von der ersten Niedertemperaturlast (120) unter Verwendung eines ersten Niedertemperaturkompressors (135);
 Komprimieren des Kühlmittels von der zweiten Niedertemperaturlast (125) unter Verwendung eines zweiten Niedertemperaturkompressors (140);
 Komprimieren des Kühlmittels von der Mitteltemperaturlast (115) und des Kühlmittels von dem zweiten Niedertemperaturkompressor (140) unter Verwendung eines Mitteltemperaturkompressors (130);
 wobei dann, wenn ein paralleler Kompressor (205) eingeschaltet ist, die folgenden Schritte ausgeführt werden:

Leiten des Kühlmittels von dem ersten Niedertemperaturkompressor (135) durch ein erstes Ventil (210) zu den parallelen Kompressor (205) und weg von dem Mitteltemperaturkompressor (130); und

- Komprimieren des Kühlmittels von dem ersten Niedertemperaturkompressor (135) und des Flash-Gases unter Verwendung des parallelen Kompressors (205); 5
- wobei dann, wenn der parallele Kompressor (205) ausgeschaltet ist, die folgenden Schritte ausgeführt werden:
- Leiten des Kühlmittels von dem ersten Niedertemperaturkompressor (135) durch das erste Ventil (210) zu dem Mitteltemperaturkompressor (130) und weg von dem parallelen Kompressor (205); 10
- Leiten des Flash-Gases von dem Entspanner durch ein zweites Ventil zu dem Mitteltemperaturkompressor (130) und weg von dem parallelen Kompressor (205); und 15
- Komprimieren des Kühlmittels von dem ersten Niedertemperaturkompressor (135) und des Flash-Gases durch den Mitteltemperaturkompressor (130). 20
2. Verfahren nach Anspruch 1, wobei das erste Ventil ein Dreiwegeventil (210) ist. 25
3. Verfahren nach einem der vorhergehenden Ansprüche, wobei:
- der dritte Raum auf einer höheren Temperatur als der erste Raum und der zweite Raum ist; und der zweite Raum auf einer niedrigeren Temperatur als der erste Raum ist. 30
4. Verfahren nach einem der vorhergehenden Ansprüche, das ferner die folgenden Schritte umfasst: 35
- Aufnehmen des Kühlmittels von dem Mitteltemperaturkompressor (130) und dem parallelen Kompressor (205) bei einem Ölabscheider; und Schicken des Kühlmittels zu dem hochseitigen Wärmetauscher (105). 40
5. System (200) zum Durchführen des Verfahrens nach Anspruch 1, das Folgendes umfasst: 45
- einen hochseitigen Wärmetauscher (105), der konfiguriert ist, Wärme von einem Kühlmittel abzuführen;
- einen Entspanner (110), der konfiguriert ist, das Kühlmittel von dem hochseitigen Wärmetauscher (105) zu speichern, wobei der Entspanner (110) konfiguriert ist, ein Flash-Gas abzuführen; 50
- eine erste Niedertemperaturlast (120), die konfiguriert ist, ein Kühlmittel zu verwenden, um Wärme von einem ersten Raum angrenzend an die erste Niedertemperaturlast (120) abzuführen; 55

eine zweite Niedertemperaturlast (125), die konfiguriert ist, das Kühlmittel zu verwenden, um Wärme von einem zweiten Raum angrenzend an die zweite Niedertemperaturlast (125) abzuführen;

eine Mitteltemperaturlast (115), die konfiguriert ist, das Kühlmittel zu verwenden, um Wärme von einem dritten Raum angrenzend an die Mitteltemperaturlast (115) abzuführen;

einen ersten Niedertemperaturkompressor (135), der konfiguriert ist, das Kühlmittel von der ersten Niedertemperaturlast (120) zu komprimieren;

einen zweiten Niedertemperaturkompressor (140), der konfiguriert ist, das Kühlmittel von der zweiten Niedertemperaturlast (125) zu komprimieren;

einen Mitteltemperaturkompressor (130), der konfiguriert ist, das Kühlmittel von der Mitteltemperaturlast (115) und das Kühlmittel von dem zweiten Niedertemperaturkompressor (140) zu komprimieren;

ein erstes Ventil (210);

ein zweites Ventil; und

einen parallelen Kompressor (205), wobei dann, wenn der parallele Kompressor (205) eingeschaltet ist:

das erste Ventil (210) konfiguriert ist, das Kühlmittel von dem ersten Niedertemperaturkompressor (135) zu dem parallelen Kompressor (205) und weg von dem Mitteltemperaturkompressor (130) zu leiten; und der parallele Kompressor (205) konfiguriert ist, das Kühlmittel von dem ersten Niedertemperaturkompressor (135) und das Flash-Gas zu komprimieren;

und wobei dann, wenn der parallele Kompressor (205) ausgeschaltet ist:

das erste Ventil (210) konfiguriert ist, das Kühlmittel von dem ersten Niedertemperaturkompressor (135) zu dem Mitteltemperaturkompressor (130) und weg von dem parallelen Kompressor (205) zu leiten;

das zweite Ventil konfiguriert ist, das Flash-Gas von dem Entspanner zu dem Mitteltemperaturkompressor (130) und weg von dem parallelen Kompressor (205) zu leiten; und der Mitteltemperaturkompressor (130) ferner konfiguriert ist, das Kühlmittel von dem ersten Niedertemperaturkompressor (135) und das Flash-Gas zu komprimieren.

6. System nach Anspruch 5, wobei das erste Ventil ein Dreiwegeventil (210) ist.

7. System nach Anspruch 5 oder Anspruch 6, wobei:

der dritte Raum auf einer höheren Temperatur als der erste Raum und der zweite Raum ist; und der zweite Raum auf einer niedrigeren Temperatur als der erste Raum ist.

5

8. System nach einem der Ansprüche 5 bis 7, das ferner einen Ölabscheider umfasst, der konfiguriert ist, die folgenden Schritte auszuführen:

10

Aufnehmen des Kühlmittels von dem Mitteltemperaturkompressor (130) und dem parallelen Kompressor (205); und

Schicken des Kühlmittels zu dem hochseitigen Wärmetauscher (105).

15

Revendications

20

1. Procédé comportant les étapes consistant à :

retirer de la chaleur d'un agent frigorigène à l'aide d'un échangeur (105) de chaleur côté haut ;

25

stocker l'agent frigorigène provenant de l'échangeur (105) de chaleur côté haut à l'aide d'un réservoir (110) de détente instantanée ;

évacuer une vapeur instantanée du réservoir (110) de détente instantanée ;

30

retirer de la chaleur d'un premier espace à proximité d'une première charge (120) à basse température à l'aide de l'agent frigorigène ;

retirer de la chaleur d'un deuxième espace à proximité d'une deuxième charge (125) à basse température à l'aide de l'agent frigorigène ;

35

retirer de la chaleur d'un troisième espace à proximité d'une charge (115) à température intermédiaire à l'aide de l'agent frigorigène ;

comprimer l'agent frigorigène provenant de la première charge (120) à basse température à l'aide d'un premier compresseur (135) à basse température ;

40

comprimer l'agent frigorigène provenant de la deuxième charge (125) à basse température à l'aide d'un deuxième compresseur (140) à basse température ;

45

comprimer l'agent frigorigène provenant de la charge (115) à température intermédiaire et l'agent frigorigène provenant du deuxième compresseur (140) à basse température à l'aide d'un compresseur (130) à température intermédiaire ;

50

lorsqu'un compresseur parallèle (205) est en marche :

55

faire diriger, par une première vanne (210), l'agent frigorigène provenant du premier

compresseur (135) à basse température vers le compresseur parallèle (205) et à l'écart du compresseur (130) à température intermédiaire ; et

comprimer l'agent frigorigène provenant du premier compresseur (135) à basse température et la vapeur instantanée à l'aide du compresseur parallèle (205), lorsque le compresseur parallèle (205) est à l'arrêt :

faire diriger, par la première vanne (210), l'agent frigorigène provenant du premier compresseur (135) à basse température vers le compresseur (130) à température intermédiaire et à l'écart du compresseur parallèle (205) ;

faire diriger, par une deuxième vanne, la vapeur instantanée provenant du réservoir de détente instantanée vers le compresseur (130) à température intermédiaire et à l'écart du compresseur parallèle (205) ; et

faire comprimer, par le compresseur (130) à température intermédiaire, l'agent frigorigène provenant du premier compresseur (135) à basse température et la vapeur instantanée.

2. Procédé selon la revendication 1, la première vanne étant une vanne (210) à trois voies.

3. Procédé selon l'une quelconque des revendications précédentes :

le troisième espace se trouvant à une plus haute température que le premier espace et le deuxième espace à la fois ; et
le deuxième espace se trouvant à une plus basse température que le premier espace.

4. Procédé selon l'une quelconque des revendications précédentes, comportant en outre les étapes consistant à :

recevoir l'agent frigorigène provenant du compresseur (130) à température intermédiaire et du compresseur parallèle (205) au niveau d'un séparateur d'huile ; et
envoyer l'agent frigorigène vers l'échangeur (105) de chaleur côté haut.

5. Système (200) destiné à réaliser le procédé selon la revendication 1, comportant :

un échangeur (105) de chaleur côté haut configuré pour retirer de la chaleur d'un agent frigorigène ;
un réservoir (110) de détente instantanée con-

figuré pour stocker l'agent frigorigène provenant de l'échangeur (105) de chaleur côté haut, le réservoir (110) de détente instantanée étant configuré pour évacuer une vapeur instantanée ;

une première charge (120) à basse température configurée pour utiliser un agent frigorigène afin de retirer de la chaleur d'un premier espace à proximité de la première charge (120) à basse température ;

une deuxième charge (125) à basse température configurée pour utiliser l'agent frigorigène afin de retirer de la chaleur d'un deuxième espace à proximité de la deuxième charge (125) à basse température ;

une charge (115) à température intermédiaire configurée pour utiliser l'agent frigorigène afin de retirer de la chaleur d'un troisième espace à proximité de la charge (115) à température intermédiaire ;

un premier compresseur (135) à basse température configuré pour comprimer l'agent frigorigène provenant de la première charge (120) à basse température ;

un deuxième compresseur (140) à basse température configuré pour comprimer l'agent frigorigène provenant de la deuxième charge (125) à basse température ;

un compresseur (130) à température intermédiaire configuré pour comprimer l'agent frigorigène provenant de la charge (115) à température intermédiaire et l'agent frigorigène provenant du deuxième compresseur (140) à basse température ;

une première vanne (210) :

une deuxième vanne ; et

un compresseur parallèle (205) :

caractérisé en ce que, lorsque le compresseur parallèle (205) est en marche :

la première vanne (210) est configurée pour diriger l'agent frigorigène provenant du premier compresseur (135) à basse température vers le compresseur parallèle (205) et à l'écart du compresseur (130) à température intermédiaire ; et

le compresseur parallèle (205) est configuré pour comprimer l'agent frigorigène provenant du premier compresseur (135) à basse température et la vapeur instantanée ; et

en ce que, lorsque le compresseur parallèle (205) est à l'arrêt :

la première vanne (210) est configurée pour

diriger l'agent frigorigène provenant du premier compresseur (135) à basse température vers le compresseur (130) à température intermédiaire et à l'écart du compresseur parallèle (205) ;

la deuxième vanne est configurée pour diriger la vapeur instantanée provenant du réservoir de détente instantanée vers le compresseur (130) à température intermédiaire et à l'écart du compresseur parallèle (205), et le compresseur (130) à température intermédiaire est en outre configuré pour comprimer l'agent frigorigène provenant du premier compresseur (135) à basse température et la vapeur instantanée.

6. Système selon la revendication 5, la première vanne étant une vanne (210) à trois voies.

7. Système selon la revendication 5 ou la revendication 6 :

le troisième espace se trouvant à une plus haute température que le premier espace et le deuxième espace à la fois ; et

le deuxième espace se trouvant à une plus basse température que le premier espace.

8. Système selon l'une quelconque des revendications 5 à 7, comportant en outre un séparateur d'huile configuré pour :

recevoir l'agent frigorigène provenant du compresseur (130) à température intermédiaire et du compresseur parallèle (205) ; et envoyer l'agent frigorigène vers un échangeur (105) de chaleur côté haut.

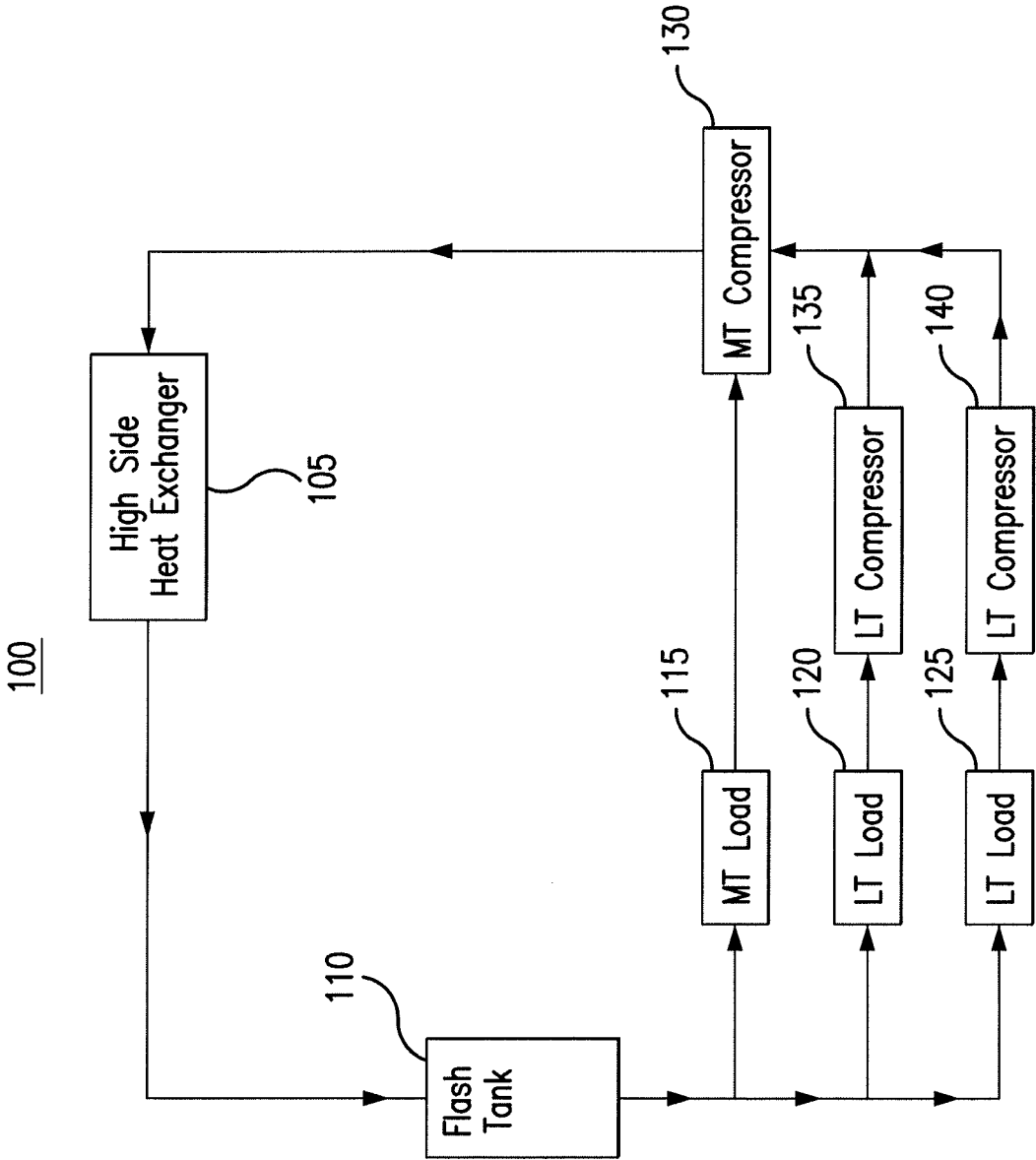


FIG. 1

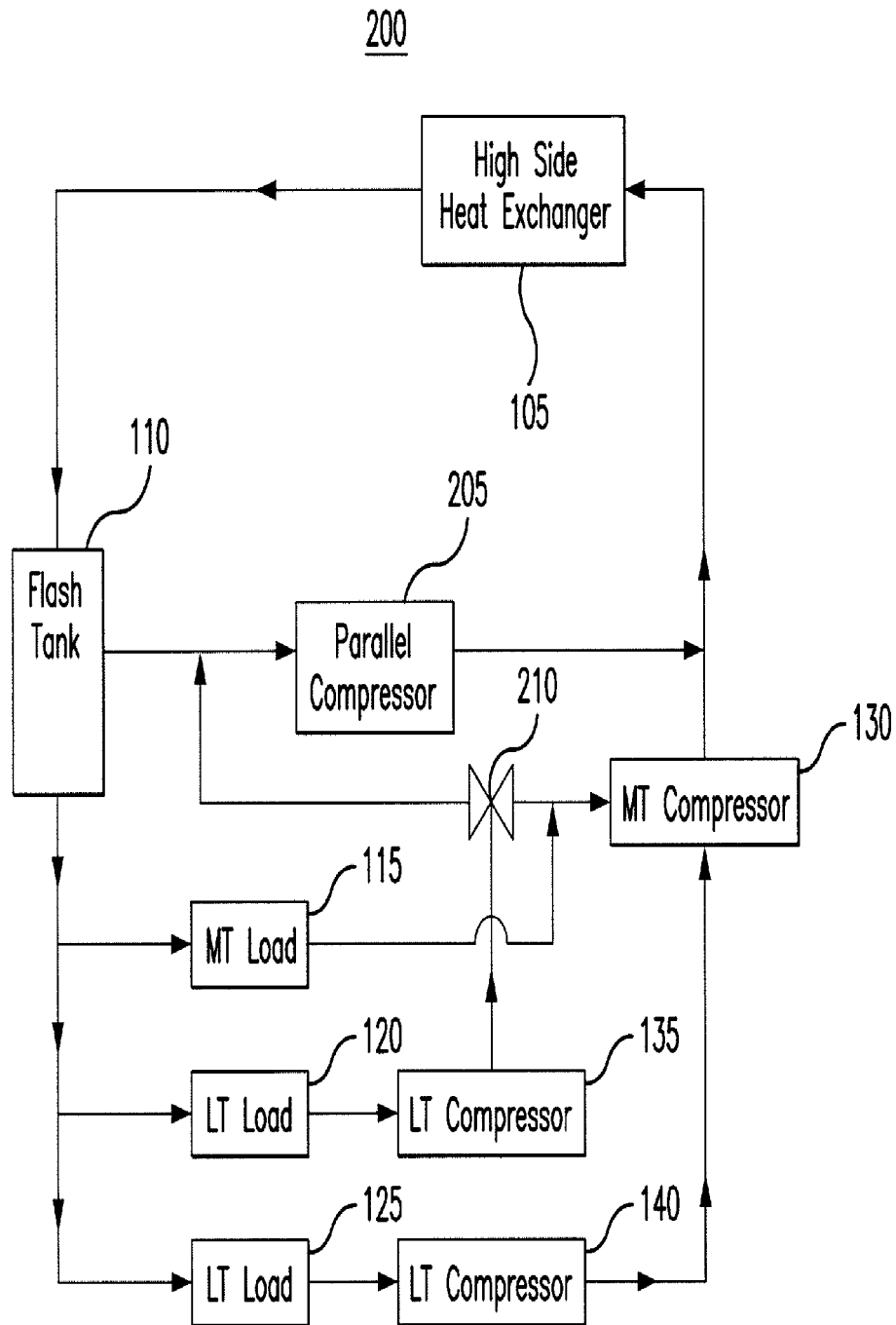
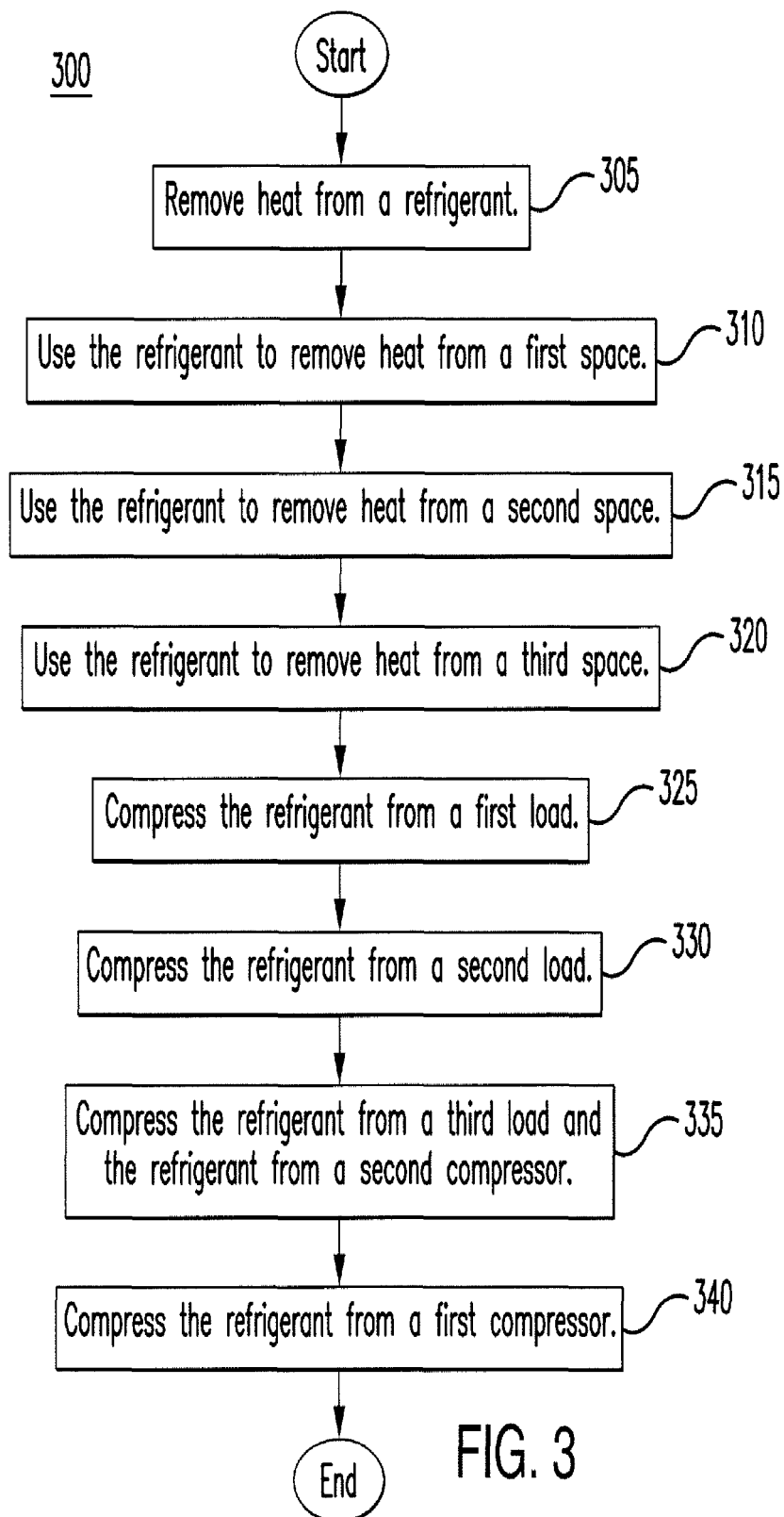


FIG. 2



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 3064866 A1 [0003]